Atomic Structure Notes

Introduction

- History behind atomic models & parts
- Discoveries that helped in the discovery
- The parts of the atom
- Models of the Atom

Atomism

- Somewhere about 400 B.C., two Greek philosophers came up with the idea of the atom.
- They were ____

  ____

  (known here after as the two dead Greek dudes).
- Their theory has five statements:

1.All matter is____

____

2.There is ______________________________between atoms.

3.Atoms are ________________________(no space within the atom).

4.Atoms are homogeneous, with__________________________________

5.Atoms are different in ______________________________________

_____________________________________(added by Epicurus later).

- Summary:

  All did not embrace this idea.
  Aristotle and others wrote against this idea.
  The early Catholic Church also did not like this theory.
  So it kind of disappeared.

Atomic Theory

- The Father of the Chemical Atomic Theory:_______________________
- He published his theories on the atmosphere and gas behaviour in a book titled *A New System Of Chemical Philosophy*. Only in the last few pages (Chapter III) did he discuss his atomic theory.

◆Four basic ideas in Dalton's chemical atomic theory

1) Chemical elements are ____

2) The atoms of an element are ____

3) Atoms of different elements have _____________________________________

4) Atoms only combine in ____

____

such as 1: 1, 1:2,2:3 and so on.

Explanation of Dalton’s Theory

1) Elements are made of atoms.

Elements are made up of minute, ____

____

These atoms maintain their identity through all ___________________________

____

2) The atoms of an element are identical in their masses.

Atoms of the **same** element have the ______________________________

____

Atoms of **different** elements have _________________________________

____

3) Atoms of different elements have different masses

In other words, while it was claimed atoms of different elements had different weights, no one could figure out what the different weight values were. Dalton was the first to do so.

4) Atoms combine in small, whole number ratios.

Chemical combination between two or more atoms occurs ____________________

____

(i.e., 1 to 1, 1 to 2; 2 to 3; etc.)

This point gives immediate explanation to the ______________________________

____

______announced by Joseph Louis Proust in 1797.

This law is sometimes called the *Law of Constant Composition*.

In a modern textbook, it is:

A given chemical compound always contains ________________________________

____

____

A different way to say it: ____

____

____

Dalton discovered the____,
another law that is easily explained by his atomic theory.
Dalton discovered this law while studying some of the oxides of nitrogen.
The law, in modern terminology, is:

Atoms of the same element can _____________________________________

____

____

____

A fifth idea implicit in Dalton's theory, but usually not discussed is this:

Atoms can be____

____

An element's atoms do not change into other element's atoms ___________

____

____

Other important discoveries

- 1858- William Geissler invents the vacuum pump. This allows scientist to study the flow of electricity in sealed glass tubes w/o air. They studied what was called cathode rays.

- 1879- William Crookes makes the 1st "cathode ray tube". Finds that cathode rays appear to be streams of negative particles because a negative charge builds on the targets struck by the rays.

- 1886 Edward Goldstein makes a "canal ray tube". He observes a ray that goes in the opposite direction than the cathode ray. Ray creates a positive charge when it hits metal. Concludes that canal rays are streams of positive particles.

- 1891- George Stoney estimates the charge on this unknown negative particle. Calls it the "electrine" which later becomes the "electron"

The Electron

- 1897- J.J. Thomson calculated the charge to mass ratio for cathode rays. Figures the rays to be ____

  ____

  (1899 completes work by measuring the charge on the electron)

- 1911- R. A. Millikan directly determined the _________________________________

____

____

Once the charge was known, the mass could be calculated.

The electron is assigned the charge _________________

◆The mass turned out to be ____

____

If all atoms contain negatively charged electrons, which contribute almost nothing to the mass of the atom, then where is the positive charge needed to make the atom have an overall neutral charge?

The Nucleus

- 1911- Ernest Rutherford found that the atom has ______________________

  ____

  later determines the nucleus to have a ______________________________

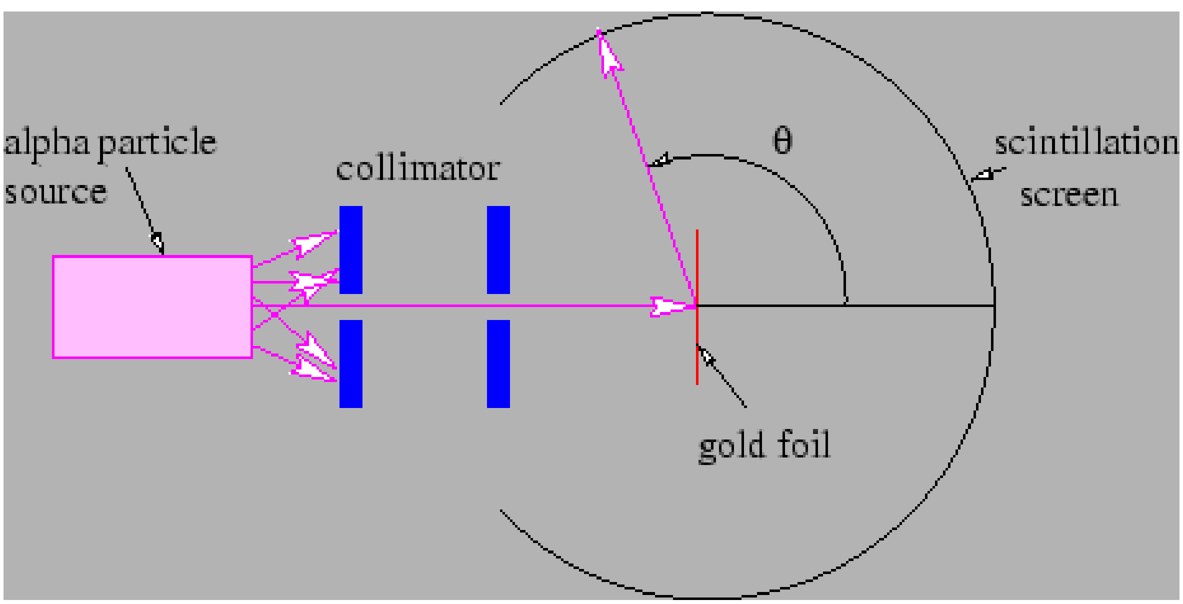
Rutherford's Gold Foil Experiment

The experiment:

Alpha particles were fired______________________________________.

Alpha particles are helium atoms _____________________________________

____



◆Results:

▪Most of the alpha particles went____

____

▪Some of the alpha particles were ______________________________________

▪Some like 1 or 2 in several thousand __________________________________

____

◆Rutherford's conclusions:

Atoms____

The center (nucleus) is ____

The nucleus has____

More on the Nucleus.

- **Henry Moseley** (1913-14) investigated the characteristic frequencies of X-rays produced by bombarding each of the elements in turn by high-energy cathode rays (electrons).
- He discovered a mathematical relationship that calculated the _____________ ____________________(the "serial number" in the periodic table).
- Also calculated the ____

Atomic number and Protons

- This must mean that the atomic number is ____________________________

  ____

  ____

- Therefore, the atomic number is ____________________________________

  ____

  ____

- Moseley was killed in action at Gallipoli in the First World War.

The neutron

- Scientist now had two parts of the atom but they could not account for the mass. Rutherford had predicted its existence but had no laboratory proof of its existence.
- 1932- James Chadwick discovers the neutron.

Bombarded small atoms (Be) with alpha particles and observed ________________ ____________which were particles similar in mass to protons but had no________ ____

Hence the neutron (1st named in 1921 by William Harkins)

Atomic Structure: Atoms

- Atoms are made of ____
- The protons and neutrons are held together in ____________________________ ____
- The nucleus is ____ ____
- The nucleus contains 99.9 % of ____
- The electrons are somewhere around the __________________________________ ____
- The size of the atom is____

Particle	Symbol	Charge	Mass	Location	AMU
Proton	p^+	+1	$1.673X10^{-24}$ g	Nucleus	1
Neutron	n^0	0	$1.675X10^{-24}$ g	Nucleus	1
Electron	e^-	-1	$9.109X10^{-28}$ g	Electron cloud	0

◆Terms:

1.Atoms are ____

____

____

2.Isotopes are atoms ____

____

____

3.Neutral atoms have no charge (zero) because ______________________________

____

____

4. Ions are atoms of an element with______________________________________

____

____

due to a difference between ____

____

5. Mass number is ____

____

6. Atomic mass is the ____

____

(all isotopes) and is measured in ____

7. Atomic number is the number ____

This number is ____

◆The Math:

protons = ____

mass# = ____

therefore # neutrons = ____

Charge on an atom: ____

____

this will be 0 or a small positive or negative number.

Fewer electrons will give an atom ______________________________

More electrons will give an atom ______________________________

Models of the Atom

Greek Model

- 400 B.C.(or somewhere about that time)

Greeks- ____

____

Dalton's Atomic Model

- early 1800's, John Dalton
- that all matter was composed ______________________________

____

- that atoms were ____

____

- Consequently, his model explained that atoms were smaller spheres.
- Atoms go together in ____

____

Thomson's Atomic Model

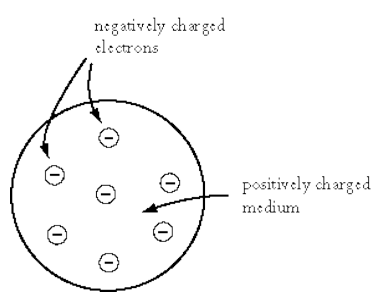
- showed how he thought these electrons were arranged.
- showed that ____

  ____

  ____

- model of the atom looks like ____________________________________

  ____



Rutherford's Atomic Model

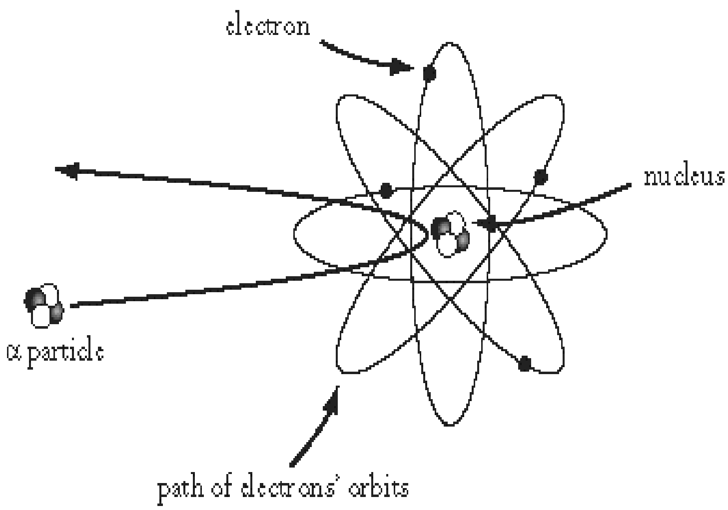
- This model suggested that most of the mass of the atom___________________

  ____

- Called_______________________________________
- that the rest of the____
- describes an atom as ____

  ____

  ____



Bohr's Atomic Model

- explained that an atom ____

  ____

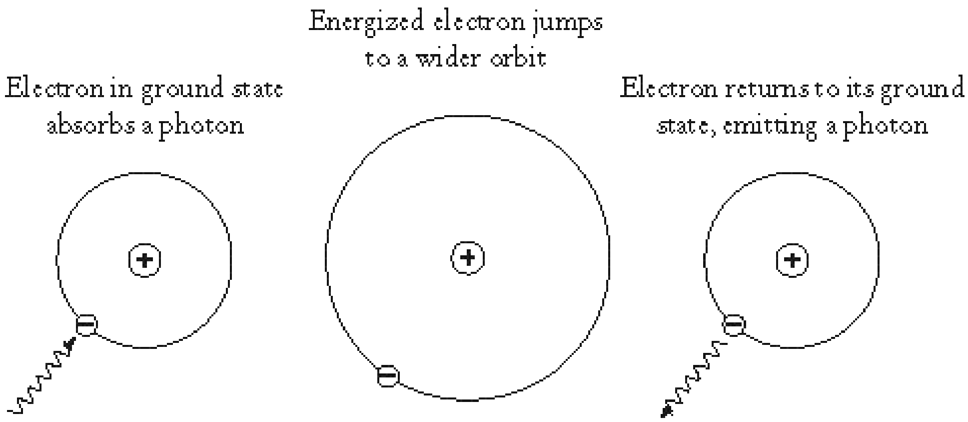
  ____

- This model suggested that the electrons ________________________________

  ____

- Looked like a ____

Bohr's Model



Quantum Mechanical Model of the Atom

- fundamental ideas of ____
- electrons do not actually ____
- the exact location of an electron in an atom______________________________

only the ____

present day model describes an atom as _________________________________

____

____

____

electron orbitals represent ____

____

____

location of an electron depends ____

____

Electrons are arranged in energy levels within a given electron cloud___________

____

such that the electrons with the lowest energy ______________________________

____

and the electron with the highest energy ____________________________________

____